REMARKS

Claims 1-23 are all the claims pending in the application. Claims 1-4, 6-17 and 19-23 are rejected. Claims 5 and 18 are objected to but are indicated as being allowable if placed into independent form. Claims 3-7, 9, 10, 17 and 19-23 are amended in order to overcome objections to language in the claim, but are not amended for purposes of patentability.

Drawings

The Examiner has objected to the drawings as being informal. Applicants will provide formal drawings upon or prior to allowance of the application, consistent with the Examiner's comments.

Claim Objections

The Examiner has objected to claims 3-7, 9-20, 22 and 23 because of certain informalities. Applicant has adopted the Examiner's suggestions in all but a couple of instances, where it is believed that the original claims accurately reflect the invention. For example, claim 9 has not been amended at line 8 because "at least one" is not needed. Also, claims 10 and 19 have not been amended to recited a second router, since a common router could suffice. Claim 20 has not been amended since either or both information and requests can be sent via the return channel.

Claim Rejections - 35 USC 112

Claims 21 and 22 are rejected under 35 USC 112, second paragraph, as being indefinite. This rejection is traversed because the basis for rejection reflects the Examiner's personal preference for language and is not based on a lack of clarity or definiteness in the claim. The language identified by the Examiner as lacking antecedent basis would be well understood by one of ordinary skill in the art and, at an extreme, may be a basis of objection. In this regard, Applicant notes that claim 22 was listed as being objectionable but no comment was provided, thus indicating that the Examiner intended to issue only an objection.

Subject to this traversal, and without waiver of Applicants' position, Applicants are changing the claim in order to advance prosecution in this case.

Claim Rejections - 35 USC 102

Claims 1-4, 6-8, 10-17, 20 and 22 are rejected under 35 USC 102 as being anticipated by Kelly et al (6,650,869). This rejection is traversed for at least the following reasons.

As a preliminary matter, Applicants note that the U.S. filing date of Kelly et al is February 15, 2001, only five weeks earlier than the Applicants' filing date. Applicants can easily swear behind the filing date of the Kelly et al patent. Kelly et al does claim priority from a provisional application (60/197,246) that was filed more than one year earlier. The Examiner has not made the provisional text available and is requested to do so (1) if he has access to it and has considered it and (2) if the rejection is maintained.

Applicants believe, however, that the rejection should be withdrawn as Kelly et al does not teach the claimed invention in any of independent claims 1, 10, and 20.

The Claimed Invention

Claim 1 is directed to a method of performing IP multicast communication in a system having a source of IP multicast communications, at least one client at destination locations and a plurality of channels including at least one bidirectional communication channel and a unidirectional communication channel that operates independently of the at least one bidirectional communication channel. The corresponding illustration of an exemplary system may be seen in Fig. 1 where the source is at an upstream location 1 and the at least one client is at destination locations 3a-3n. Bidirectional communication return channels 5a-5n couple the upstream and downstream locations via routers at each of the upstream location 13 and downstream location 27a-27n. A unidirectional link from the uplink location via the router 13, ground terminal and satellite 7 is provided for multicasting media in real time to plural downlink receiving facilities 31a-31n that are coupled to destination locations 3a-3n. The invention provides a unique method of implementing a one-way (uni-directional) multicast satellite system that operates independently of at least one bi-directional communication channel that provides system administration capability.

Claim 10 is directed to the system for IP multicast communication and includes a destination (3a-3n) that transmits a request via a return channel (5a-5n) and receives (31a-31n) an IP multicast communication from a unidirectional communication channel (7). Also included

is a source (1) that receives the request through a return channel (5) and generates and transmits the IP multicast communication to the unidirectional communication channel in accordance with the request. The unidirectional communication channel and the return channel operate independently.

Claim 20 defines the method of claim 1 with greater detail. The claim has been amended to provide a further focus on the independence between the unidirectional multicast and the bidirectional return channels.

In short, Applicant has taught and is now claiming a method and system design for a one-way (uni-directional) **multicast** system that operates **independently** of at least one bi-directional communication channel.

Kelly et al

The Examiner refers to Fig. 2 for a teaching of at least one client that requests IP multicasting from a source via the Internet network 105, asserted to be a bidirectional communication channel, and the transmitting of an IP multicast communication from a source to a destination (101) via a unidirectional channel, where satellite dish 107 operates as a unidirectional channel receiving information from NOC 113 and transmitting only unidirectionally to antenna 111. The Examiner asserts that the unidirectional channel operates independently, as claimed.

Kelly et al does teach the provision of multimedia services from NOC (hub) 113 on the basis of a one-way IP multicast transport. Kelly et al also teaches that a user 101 can access networks 103, 105 via the Internet. All of the communication between NOC 113 and users 101 in Kelly et al's system are via satellite links 107, as illustrated in Fig. 1.

However, Applicant respectfully submits that the arrangement illustrated in Figs. 1 and 2 of Kelly et al relates to a two-way satellite system, whereby the flow of IP multicast routing is subject to an inter-dependency between the hub-to-remote link and the remote-to-hub link. There is no combination of unidirectional communication channel and bidirectional return channel that operate independently, nor is there any teaching or suggestion in Kelly et al that there can be independent operation. In fact, Applicant respectfully submits that Kelly et al cannot support independent operation. Moreover, Kelly et al is fundamentally deficient in that it

does not teach how IP multicast requests can be transferred from destinations to a source over the Internet, which is a unicast network.

In particular, the Examiner cannot point to any teaching of independent operation of a multicast unidirectional link and a bidirectional link. As illustrated in Fig. 2, all of the communications flow between the user 101 and the destinations where there are multimedia 103, 105 is via a common link through a satellite 107. The links in all directions are closely coupled.

In order to assert that there is the claimed independence, the Examiner appears to assume that dynamic multicast routing would work seamlessly if the two links are de-coupled (made independent). However, it is fundamental to IP multicast routing that a "reverse path forwarding mechanism" must be used. Simply put, the reverse path forwarding mechanism requires any IP multicast-enabled router to send a request for multicast traffic on a specific interface connected to a link and to expect the multicast traffic to be returned (flow) from the very same link. If the links are decoupled as in the case of a one-way satellite system, IP multicast would not work. See for example, "*Multicasting on the Internet and its Applications*"- Sanjoy Paul where at page 30 the author states.

> "If a packet (multicast packet) is received on the interface that the router uses to send packets (requests) to the sender, only then will the packet be forwarded along the other interfaces. Otherwise, the packet is dropped."

Clearly, one skilled in the art would understand that, in accordance with conventional protocols, the multicast packet must be received on the interface that the router uses to send requests. Parallel and independent transmission of requests and receipt of multicast transmissions, as may be envisioned by the Examiner using Kelly et al, would not work.

With regard to claim 4, the Examiner refers to modulator 405, which is discussed at col. 10, lines 18-19 and 25-28. Applicants note that this reference is to a modulator that encodes and modulates baseband into DVB transport stream. This is commonly known as channel coding. Applicants' claim 4 refers to a different kind of encoding, which is video encoding – baseband video and audio signals (both analog and digital) are encoded and compressed to different bit rates and formats. This type of coding is also known as source coding. Clearly, these types of encoding are different.

With respect to the remaining claims that the Examiner asserts are anticipated, they further define features of the independent claims from which they depend.

Claim Rejections - 35 USC 103

Claims 3, 9 and 23 are rejected under 35 USC 103(a) as being unpatentable over Kelley et al (6,650,869). This rejection is traversed for at least the following reasons.

The Examiner asserts that Kelly et al teaches the claimed method of configuring IP multicast communication, including the claimed step of "(a) requesting the IP multicast communications from a client in one of a plurality of downstream networks to an upstream network via a corresponding bi-directional return channel". However, the Examiner's comment in support of this assertion indicates that his comment is based on a fundamental misunderstanding that the Internet itself is a bi-directional channel. The Internet, although bi-directional, **cannot** handle IP multicast requests because it is predominantly a unicast network.

The present invention, as disclosed and claimed, uses multicast requests that flow over a unicast bi-directional return channel. Specifically, the invention uses a combination of MRoute proxy and unidirectional link routing technologies to enable encapsulated multicast requests to flow over a unicast bi-directional return channel.

The Examiner also asserts that Kelly et al teaches the claimed step of "(b) encoding a live media stream in the IP multicast communication and transmitting the IP multicast communication generated at the upstream network to at least one downstream network via a unidirectional satellite that operates independently of the corresponding return channel, the transmission of the live media occurring in real-time without being stored at the destination prior to receipt by the client." However, Applicants respectfully submit that in this analysis, the examiner mistakenly compares the process of encoding a live media stream to the functionality of a modulator device identified in Kelly's patent. A media encoder performs source coding to reduce bandwidth or required storage, whereas a modulator performs channel coding to protect information against transmission errors.

The Examiner admits that Kelly et al does not disclose "recording a receiving time" or "recording a termination time," as in claims 3 and 9. The Examiner asserts that Kelly teaches at col. 14, lines 30-34 the measuring and reporting of usage on the channels. The Examiner further

asserts that Kelly teaches at col. 5, lines 34-36 that waste due to unused allocated bandwidth is minimized. The Examiner then concludes that these further limitations are obvious.

Applicants respectfully submit that these teachings do not provide the detailed limitations set forth in the claims and that the Examiner is merely using hindsight to recreate the Applicants' invention from scant disclosure in Kelly et al. Applicants further submit that even with hindsight, the details are nowhere to be found in Kelly et al.

Allowable Subject Matter

The Examiner considers claims 5 and 18 to be allowable if placed into independent form. Applicant is grateful for the Examiner's indication of allowability, but believes that the parent claims also are patentable and that there is no present need to place claims 5 and 18 in independent form.

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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MULTICASTING ON THE INTERNET AND ITS APPLICATIONS

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1998

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combines the center-based tree approach (for the RP-based shared tree) with an approximate version of Bellman-Ford algorithm (for the source-based shortest path tree).

3.5 Summary

There are two fundamental approaches in designing multicast routing algorithms - one is to minimize the distance (or cost) from the sender to each receiver and the other is to minimize the overall cost of the multicast tree. Practical considerations lead to a third category of algorithms which try to optimize on both constraints using some metric. However, majority of the multicast routing protocols used in the Internet today are based on shortest path trees because they are easy to implement and they provide minimum delay from the sender to each receiver, which is a desirable property for most of the real-life multicast applications. The only reason some of the recent proposals for multicast routing protocols consider using shared trees as opposed to per source shortest path trees is for reducing state information in the routers rather than for minimizing the overall cost.

Chapter 4

IP Multicast

The objective of this chapter is to describe the fundamental techniq which led to the evolution of multicasting in the Internet. *IP multic* is the mechanism used in the Internet for constructing the multicast t at the IP layer (*network-layer* of the Internet).

The key problem in IP multicast is to enable efficient *routing* of pa ets from a sender to multiple receivers in a loop-free manner. Efficie can be measured in terms of a variety of parameters, such as, minim network resources, minimum delay between the sender and each recei or some other metric. To ensure freedom from loops, the tree-build protocol has to be careful in not selecting a link during the tree constr tion phase that will lead to the formation of a loop. One of the earli techniques aimed at achieving this goal was *Reverse Path Forwar* (RPF) [DM78].

4.1 Reverse Path Forwarding

Reverse Path Forwarding (RPF) builds a source-based tree such that distance between the sender and any receiver is minimum. The ide RPF can be explained using Figure 4.1. In Figure 4.1, there are sev

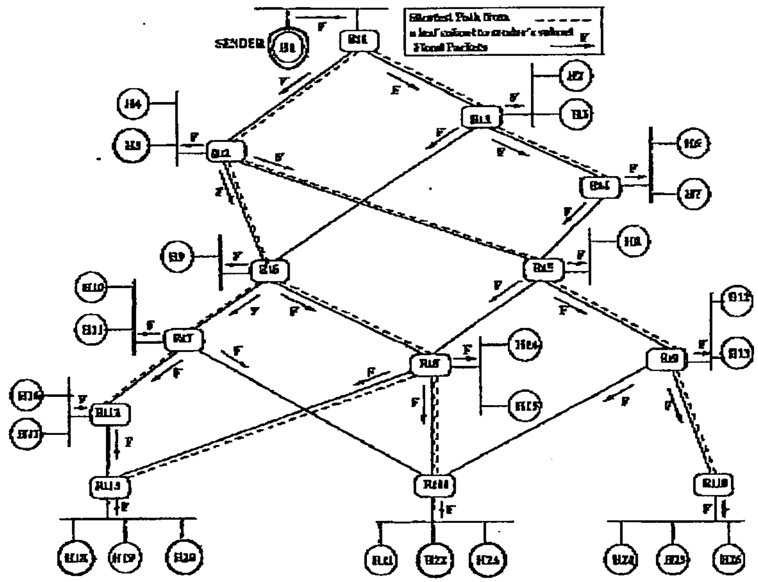

Figure 4.1: Reverse Path Forwarding

subnets, each containing one or more hosts. Hosts are represented by circles with a label Hi (where i = 1, ..., 26). Routers are represented by rectangles with a label Rtj (j=1, ..., 10). Assume that host H1 is the sender and Rt1 is the router on its subnet. The goal is to route packets to all the subnets in a distributed manner without causing loops.

The key idea is to "flood" packets in such a way that loops are avoided. Note that if pure flooding is used, an intermediate router will receive the same packet several times, because each of its neighboring routers will forward the packet to it at least once. RPF provides the following forwarding rule for a router:

If a packet is received on the interface that the router uses to send packets to the sender, only then will the packet be forwarded along the other interfaces. Otherwise, the packet will be dropped.

This is called *reverse* path forwarding because only those packets are forwarded that arrive on the *reverse* shortest path from the router to the

sender.

With respect to Figure 4.1, the packet from the sender is forwa by Rt1 along both of its outgoing interfaces (towards Rt2 and Rt3). forwards the packet along its outgoing interfaces towards Rt5 and because the packet was received on the Rt2-Rt1 interface which is by Rt2 to send packets to the sender. However, the packet receive Rt5 from Rt4 will *not* be forwarded because Rt5-Rt4 is *not* the inte Rt5 uses to send packets to the sender. In the diagram, the sho path of each router to the sender is indicated by dashed lines.

Effectively, this simple scheme achieves the desired goal of rou packets from the sender to the receivers (assuming there are rece on every subnet) in a loop-free way. RPF, by itself, is not enougl multicast routing on the Internet, simply because there is no notic *group membership* built into it. More specifically, RPF works wit taking into account where the members of a multicast group are loc in the network. Therefore, RPF is really a technique for buildi *broadcast* tree as opposed to a technique for building a *multicast* which spans *only* the members of a multicast *group*.

Steve Deering proposed the Internet Group Management Pro (IGMP) [D89] as a mechanism to integrate the group membership i mation into the multicast routing protocols.

4.2 Internet Group Management Protocol

IGMP was first proposed in 1989 and documented as RFC-1112 (extensions for IP multicasting) [D89]. Since then it has gone through eral modifications resulting in IGMP version-2 [F97] and IGMP versi [CDT97].

The key *ideas* of IGMP can be stated as follows:

1. An IGMP-capable router periodically broadcasts an IGMP I Membership Query message on its subnet.

2. If there is a host on the subnet that subscribes to a grou schedules a random timer to send an IGMP Host-Membershir port message to the corresponding *group members*. Note tha IGMP Host-Membership Report is *not* broadcast to every hoi the subnet.